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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/594,052	11/24/2006	Wolfgang Schulz	GRIMM 237-KFM	8967

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EXAMINER	
WASAFF, JOHN SAMUEL	
ART UNIT	**PAPER NUMBER**
3742	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/594,052	SCHULZ ET AL.	
	Examiner	Art Unit	
	JOHN WASAFF	3742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 September 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 September 2006* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *12/11/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings are objected to under 37 CFR 1.83(a) because of missing text in Fig. 2, as described in the specification. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) TITLE OF THE INVENTION.
(b) CROSS-REFERENCE TO RELATED APPLICATIONS.
(c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
(d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
(e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
(f) BACKGROUND OF THE INVENTION.
    (1) Field of the Invention.
    (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(g) BRIEF SUMMARY OF THE INVENTION.
(h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
(i) DETAILED DESCRIPTION OF THE INVENTION.
(j) CLAIM OR CLAIMS (commencing on a separate sheet).
(k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
(l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

Claim Objections

1. The claims are objected to because they include reference characters which are not enclosed within parentheses.

Reference characters corresponding to elements recited in the detailed description of the drawings and used in conjunction with the recitation of the same element or group of elements in the claims should be enclosed within parentheses so as to avoid confusion with other numbers or characters which may appear in the claims. In this case, applicant uses reference characters. In this case, applicant uses variations of reference characters I, ΔI, w, r, l, d, α, etc. See MPEP § 608.01(m).

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. In claim 1, lines 5-6, it is unclear what applicant means by "the required modification." For the purposes of examining, examiner has interpreted this to simply mean "a modification."

5. In claim 1, line 9, it is unclear what applicant means by "the changing bottom of the borehole." For the purposes of examining, examiner has interpreted this to mean that the bottom of the borehole is changing due to the impingement by the laser.

6. In claim 1, lines 10-16, it is unclear what applicant means by "intensity I inside the segment w_0 at a distance w from the laser beam axis falls by the value ΔI, said drop occurs monotonously." It is unclear to the examiner how w differs from w_0. Further, it is also unclear what direction distance w extends from the laser beam (radial? perpendicular? multidirectional?). For the purposes of examining, this was interpreted to simply read "an intensity I inside a segment w_0 at a [radial] distance from the laser beam falls by the value ΔI."

7. In claim 1, line 12, it is unclear what applicant means by "monotonously." For the purposes of examining, this was interpreted to mean monotonically (i.e., continuously decreasing, although the rate of decrease might fluctuate).

8. In claim 2, line 3, it is unclear what applicant means by "root." For examining purposes, this was interpreted to mean square root. Additionally, the term "approximately" in line 3 makes the claim vague and indefinite.

9. In claim 3, line 3, the term "approximately" is vague and indefinite.

10. In claim 4, lines 3-6, it is unclear what applicant means by "maximum aspect ratio α of borehole depth *l* to borehole diameter d and the minimum diameter $d_{min} > 1/\alpha$ ($d_{min} = 2r_{Bmin}$) of the borehole are set by the following rule $\alpha <$ const. Δw_0." For the purposes of examining, this has been interpreted to mean that "the maximum aspect ratio α of borehole depth *l* to borehole diameter d and the minimum diameter $d_{min} > 1/\alpha$ are set by the rule that α is less than the product of a constant and a change in w_0, that change in w_0 being the difference between radial w_0 values at different depths of the borehole." Note that a term as vague as "constant" has been interpreted to mean any constant value, since none is defined in the claim.

11. In claims 8 and 9, the limitation "the process emissions" is unclear and lacks antecedent basis. For the purposes of examining, this was interpreted to mean the characteristics of the laser system.

12. In claim 11, lines 2-3, it is unclear what applicant means by "the additional heating is increased with an increasing depth of the borehole" (is this occurring as borehole depth increases in value?). For the purposes of examining, this has been interpreted to mean that additional heating is provided during the time the drilling operating is taking place.

13. In claim 12, line 3, the term "the melt" lacks antecedent basis.

14. In claim 13, line 3, the term "the resonator" lacks antecedent basis.

15. In claim 14, lines 2-3, it is unclear what is meant by "the heat radiation is generated by excitation of higher modes." For the purposes of examining, higher mode excitation is interpreted simply to mean higher laser intensity.

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. Claims 1-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noddin (US Patent No. 5,910,255) in view of Siegman (Lasers, 1986).

18. In claim 1, Noddin teaches a method of laser processing that produces blind and through-vias of different aspect ratios (col. 8, lines 55-65), in metallic materials, layered metallic

materials and materials comprising at least one ceramic layer, by means of laser radiation (laser irradiation of multiple layers described, including dielectric materials having ceramic filler; col. 18, ln. 25-30), the intensity of the laser beam being adjusted according to the required modification of the borehole radius in relation to the borehole depth (Noddin adjusts intensity in relation to depth as well as desired aspect ratio, i.e., radius in relation to depth; col. 8, ln. 60-65; col. 12, ln. 35-50).

Noddin does not specifically teach the spatial distribution of the intensity of the laser beam, in relation to the changing bottom of the borehole, is adjusted in such a way that the intensity I inside the segment w_0 from the laser beam axis falls by the value ΔI, the drop occurs monotonously, and values are set for the spatial modification of ΔI of the intensity I and for the segment w_0 that are so high that a borehole radius is larger than the segment w_0, the segment w_0 being the radius of the laser beam.

It would have been obvious to one of ordinary skill in the art at the time of the invention that a laser impinging on a surface has an intensity profile such that the intensity of the laser beam falls in value the further from the center of the beam (Siegman, pp. 663-666). Such a description of a laser beam fits the Gaussian profile as described in Siegman. Further, because of the Gaussian profile of the laser, the resulting borehole radius will be larger than the radius of the laser beam.

19. In claim 2, Noddin teaches the segment w_0 is set approximately in proportion to the root of the predefined borehole depth *l* to be achieved (Noddin doesn't explicitly teach a value of segment w_0 but does provide an entry diameter, which, assuming the entry diameter is close in

size to the laser beam width, translates into a value *approximately* proportional to a square root of the borehole depth; from col. 8, ln. 55 to col. 9, ln. 5).

20. In claim 3, Noddin teaches the spatial modification ΔI of intensity I is set approximately in proportion to the predefined borehole depth *l* to be achieved (laser focal spot adjusted accordingly so that the energy density varies depending on the layer of the substrate; col. 12, ln. 35-50).

21. In claim 4, Noddin teaches the maximum aspect ratio α of borehole depth *l* to borehole diameter d (aspect ratio between via depth and diameter in range of 3:1 to 25:1; see col. 8, ln. 55-65) and the minimum diameter $d_{min}>1/\alpha$ ($d_{min} = 2r_{Bmin}$) of the borehole are set by the following rule: the maximum aspect ratio α of borehole depth *l* to borehole diameter d and the minimum diameter $d_{min}>1/\alpha$ are set by the rule that α is less than the product of a constant and a change in w_0, that change in w_0 being the difference between radial w_0 values at different depths of the borehole (i.e., aspect ratio provided by Noddin is less than the product of a constant and a change in w_0 at different depths), the spatial modification $\Delta I=I_0 - Iw_0$ being intensity I within the segment w_0, and I_0 being the intensity on the laser beam axis and Iw_0 the intensity at the distance w_0 from the laser beam axis (Noddin describes a change in intensity between layers in the laminate; col. 12, ln. 35-50).

22. In claim 5, Noddin teaches for enlarging the borehole diameter d ($=2r_B$) during drilling the maximum value $I_0>I_{min}$ for the intensity is controlled or regulated such that the borehole diameter d ($=2r_B$) reaches a predetermined depth-dependent value $d>d_{min}$ (aspect ratio defined by Noddin provides for diameter dependent on depth; col. 8, ln. 55-65), I_0 being the intensity on the laser beam axis and I_{min} the minimum value of intensity I_0 (Noddin's laminated structure requires

multiple changes in intensity such that the diameter is roughly constant as the laser drills deeper into the substrate; see col. 19, ln. 35-55; Fig. 7A).

23. In claim 6, Noddin teaches enlarging the borehole diameter d ($=2r_B$) during drilling the segment $w_0>w_{min}$ is controlled or regulated such that the borehole diameter d ($=2r_B$) reaches a predetermined depth-dependent value $d>d_{min}$ (aspect ratio defined by Noddin provides for diameter dependent on depth; col. 8, ln. 55-65), w_0 being the radial distance from the laser beam axis and w_{min} the minimum distance from the laser beam axis over which the spatial modification ΔI takes place (Noddin's laminated structure requires multiple changes in intensity such that the diameter is roughly constant as the laser drills deeper into the substrate; see col. 19, ln. 35-55; Fig. 7A).

24. In claim 7, Noddin teaches when different material layers are drilled the intensity distribution of the laser radiation is adapted during transition from one layer of material to the next one in such a manner that the same or the predetermined depth-dependent borehole diameter is achieved in both material layers (Noddin's laminated structure comprises different material layers that require multiple changes in intensity such that the diameter is roughly constant as the laser drills deeper into the substrate; see col. 19, ln. 35-55; Fig. 7A).

25. In claim 8, Noddin teaches the transition between two material layers is monitored by changing the process emissions (control provided by computer 36; col. 10, ln. 45-50).

26. Claims 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noddin (US Patent No. 5,910,255) in view of Siegman (Lasers, 1986), and further in view of Blumenfeld et al. (US PGPub. No. 2005/0061779).

27. Noddin in view of Siegman teaches all the features as set forth above, but does not teach the change in the process emissions is detected by coaxial or lateral high-speed photography.

Blumenfeld et al. teaches a laser ablation feedback spectroscopy that uses optical means such as a photometer to detect accurately the ablation particles (para. [0036] of Blumenfeld).

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine Noddin and Siegman with Blumenfeld et al., in order to provide improved control of the ablation process and an additional means for in-process acceptance testing of each work-piece (para. [0036] of Blumenfeld).

28. Claims 10-16, 19, 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noddin (US Patent No. 5,910,255) in view of Siegman (Lasers, 1986), and further in view of Wynn (EP0796695).

29. Noddin in view of Siegman teaches all the features as set forth above, including heat radiation is generated through beam shaping in the resonator in such a manner that the intensity of the laser beam is annularly irradiated onto the borehole for heating the borehole wall (i.e., Noddin describes an Nd:YAG laser, which is known in the art to provide a thermal energy output; col. 11, ln. 15-20); the heat radiation is generated by excitation of higher modes at least after the predetermined borehole diameter has been reached (Noddin describes adjusting laser intensity to provide for predetermined layer/depth; col. 12, ln. 35-50); the heat radiation is generated by way of apertures, the central portion of the laser beam being masked (laser controlled by optics system that includes mirrors 24 and 26, focusing lens 28, and mask 30; col. 10, ln. 25-35); the laser radiation is shaped by an optical component outside the resonator such

that a central portion of the laser beam produces the predetermined borehole diameter and an annular outer portion of the laser beam is irradiated onto the borehole for heating the borehole wall (laser source that provides heat is directed through an aperture, i.e., optical system defined by mirrors 24, 26, focusing lens 28, and mask 30; col. 10, ln. 25-35); heat radiation is generated via a laser beam source, the generated plasma acting as a secondary heat source on the wall of the borehole, the same laser beam source as the one used for drilling is used for generating the heat radiation (i.e., Noddin describes an Nd:YAG laser, which is known in the art to provide a thermal energy output; col. 11, ln. 15-20).

Noddin does not teach: a set borehole diameter d is reached the borehole wall is heated in addition; the additional heating is increased with an increasing depth of the borehole; the additional heating is limited to the melt flowing out of the borehole; heat radiation is generated via a plurality of annularly arranged diode lasers.

Wynn teaches a method of drilling holes in solid materials by laser irradiation with single or multiple laser beams, where the material is heated to at least 25 degrees C above ambient temperature (see abstract). A steady increase in temperature results in an increase in the exit hole size of the material and a reduction in laser pulse energy (see Figs. 3-4; col. 5, ln. 15-35 of Wynn).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Noddin to include the features of Wynn. The motivation is for a laser drilling method that can produce larger holes with less laser pulses (see col. 3, ln. 25-30 of Wynn).

30. Claims 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noddin (US Patent No. 5,910,255) in view of Siegman (Lasers, 1986), and further in view of Wynn (EP0796695) and Makosch et al. (US Patent No. 4,275,288).

31. Noddin in view of Wynn teaches all the features as set forth above, but does not teach an axicon is used as the optical component outside the resonator.

Makosch et al. teaches a laser beam is directed to a glass cone or axicon which converts the Gaussian energy distribution of the laser beam to one more uniform in cross-section (see abstract).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the axicon as taught by Makosch et al., since it is a well-known lens with a conical surface.

32. Claims 18, 20-23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noddin (US Patent No. 5,910,255) in view of Siegman (Lasers, 1986), and further in view of Wynn (EP0796695) and Moslehi et al. (US Patent No. 5,156,461).

33. Noddin in view of Siegman and Wynn teaches all the features as set forth above, but does not teach: heat radiation is coupled into the borehole via a second source of energy in the form of thermal energy; heat radiation is generated via a thermal light source (e.g., halogen lamp, arc lamp, vapor lamp).

Moslehi et al. teaches heating semiconductor wafers with a halogen lamp (one of ordinary skill would be able to use a different thermal energy source, e.g., one of light sources listed above).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a secondary energy source to provide thermal energy to the borehole. The motivation is for production of boreholes with less laser energy expended.

34. Claims 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noddin (US Patent No. 5,910,255) in view of Siegman (Lasers, 1986), and further in view of Wynn (EP0796695) and Blumenfeld et al. (US PGPub. No. 2005/0061779).

35. Noddin in view of Siegman and Wynn teaches all the features as set forth above, but does not teach the change in the process emissions is detected by coaxial or lateral high-speed photography.

Blumenfeld et al. teaches a laser ablation feedback spectroscopy that uses optical means such as a photometer to detect accurately the ablation particles (para. [0036] of Blumenfeld).

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine Noddin and Siegman with Blumenfeld et al., in order to provide improved control of the ablation process and an additional means for in-process acceptance testing of each work-piece (para. [0036] of Blumenfeld).

Conclusion

36. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. (See Notice of References Cited form).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOHN WASAFF whose telephone number is (571)270-1283.

The examiner can normally be reached on Monday through Friday, 7:30am to 5:00pm, alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tu Hoang can be reached on (571)272-4780. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOHN WASAFF/
Examiner, Art Unit 3742
06/17/10

/M. Alexandra Elve/
Primary Examiner, Art Unit 3742